PATENT ABSTRACTS OF JAPAN

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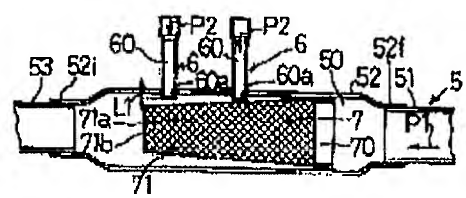
(54) PIPING UNIT AND AIR CONDITIONER HAVING SUCH PIPING UNIT

(57)Abstract:
PURPOSE: To provide a piping unit advantageous in maintaining silence and comfortableness by reducing or avoiding a high-frequency noise offensive to the ear, which is made when a high-pressure fluid in high-pressure pipe bodies is ejected into a low-pressure pipe body.

CONSTITUTION: A piping unit is provided with a low-pressure pipe body 5 having a low-pressure passage 50 through which a low-pressure fluid flows and high-pressure bodies 6, each having a high-pressure passage 60 through which a high-pressure fluid flows. A net body 71 is arranged in a region in the low- pressure passage 50, which is opposed to an opening 60a at the top end of each high-pressure passage 60.



[What is claimed is]

1. A piping device comprising:

a low-pressure pipe body including a low-pressure passage through which a low-pressure fluid flows;

high-pressure pipe bodies each including a high-pressure passage through which a fluid of a pressure higher than a pressure of the fluid in the low-pressure passage flows, a tip opening of the high-pressure passage communicating to the low-pressure passage; and

a mesh body disposed in a region of the low-pressure passage of the low-pressure pipe body facing the tip opening of the high-pressure passage, the fluid of the high pressure ejected from the tip opening of the high-pressure passage hitting the mesh body.

2. An air conditioner including a piping device, comprising:

a compressor that compresses a refrigerant in a gaseous state into a high-pressure and high-temperature state;

a condenser that condenses the high-pressure, high-temperature, and gaseous refrigerant obtained by compression of the compressor to a liquid;

an expander that expands the refrigerant obtained by the condenser;

a group of evaporators that evaporates the refrigerant that has passed through the expander to generate cold heat;

a main pipe for passage of the refrigerant, the main pipe comprising a forward path and a return path, the forward path extending from the compressor to the group of evaporators through the condenser and the expander to send the refrigerant from the compressor, the return path extending from the group of evaporators to the compressor to return the refrigerant to the compressor;

bypass paths through which the high-pressure, high-temperature, and gaseous refrigerant obtained by

compression of the compressor passes, each bypass path communicating a low-pressure passage portion of the return path of the main pipe and a high-pressure passage portion of the forward path of the main pipe between the compressor and the condenser; and

an open/close valve provided in the bypass path in such a manner that the open/close valve may be opened and closed; wherein

a mesh body is disposed in a region of the low-pressure passage portion of the return path of the main pipe facing a tip opening of the bypass path, the high-pressure, high-temperature, and gaseous refrigerant ejected from the tip opening of the bypass path hitting the mesh body.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a piping device and an air conditioner including the piping device. The present invention may be applied to an air conditioner of a type in which a compressor for refrigerant compression is driven by an engine, for example.

[0002]

[Related Art]

A related art will be described, taking an engine-driven type air conditioner as an example. Traditionally, a compressor of a variable rotation speed type that is driven by an engine, a four-way switching valve, an outdoor heat exchanger, an expansion valve and a plurality of indoor heat exchangers have been disposed in a refrigerant circuit of the engine-driven type air conditioner.

[0003]

A rotation speed control range of the engine that drives the compressor is on the order of 1000 to 2500 rpm, for example.

A ratio of a maximum rotation speed to a minimum rotation speed is approximately two to three times. Accordingly, a capacity control range of the compressor also becomes a range of approximately two or three times of a minimum capacity. Operation of a part of the indoor heat exchangers may be stopped, depending on a condition of use. The applicant has developed an air conditioner of a type in which the rotational speed of the compressor is reduced in this case to decrease the quantity of flow of a refrigerant that is supplied to the inner heat exchangers. In the air conditioner of this type, a bypass path that connects a high-pressure passage portion of a forward path and a low-pressure passage portion of a return path is further provided, and an open/close valve that opens or closes the bypass path is provided. Then, when the operation of the part of the indoor heat exchangers is stopped, the open/close valve is opened, thereby opening the bypass path. The refrigerant in a high-pressure, high-temperature, and gaseous state is thereby returned to the low-pressure passage portion of the return path through the bypass path.

[0004]

[Problem to be Solved by the Invention]

When the high-pressure, high-temperature, and gaseous refrigerant is returned to the low-pressure passage portion of the return path through the bypass path as mentioned above, the high-pressure, high-temperature, and gaseous refrigerant ejects into the low-pressure passage portion of the return path at high speed. For that reason, an unpleasant high-frequency sound (of 8000 to 20000 hertz, for example) tends to be produced. Silence and comfort may be thereby impaired.

[0005]

The present invention has been made in view of the above-mentioned actual situation. An object of the

invention as set forth in claim 1 is to provide a piping device that reduces or avoids an unpleasant high-frequency sound and is advantageous for ensuring silence and comfort. The unpleasant high-frequency sound is produced when a high-pressure fluid of a high-pressure pipe body ejects into a low-pressure pipe body. An object of the invention as set forth in claim 2 is to provide an air conditioner that reduces or avoids an unpleasant high-frequency sound and is advantageous for ensuring silence and comfort. The unpleasant high-frequency sound is produced when a high-pressure refrigerant ejects into a low-pressure return path.

[0006]

[Means for Solving the Problem]

A piping device as set forth in claim 1 comprises:

a low-pressure pipe body including a low-pressure passage through which a low-pressure fluid flows;

high-pressure pipe bodies each including a high-pressure passage through which a fluid of a pressure higher than a pressure of the fluid in the low-pressure passage flows, a tip opening of the high-pressure passage communicating to the low-pressure passage; and

a mesh body disposed in a region of the low-pressure passage of the low-pressure pipe body facing the tip opening of the high-pressure passage, the fluid of the high pressure ejected from the tip opening of the high-pressure passage hitting the mesh body. A refrigerant in a gaseous state, air, or other gas may be adopted as the fluid.

[0007]

An air conditioner including a piping device as set forth in claim 2 comprises:

a compressor that compresses a refrigerant in a gaseous state into a high-pressure and high-temperature state;

a condenser that condenses the high-pressure,

high-temperature, and gaseous refrigerant obtained by compression of the compressor to a liquid;

an expander that expands the refrigerant obtained by the condenser;

a group of evaporators that evaporates the refrigerant that has passed through the expander to generate cold heat;

a main pipe for passage of the refrigerant, the main pipe comprising a forward path and a return path, the forward path extending from the compressor to the group of evaporators through the condenser and the expander to send the refrigerant from the compressor, the return path extending from the group of evaporators to the compressor to return the refrigerant to the compressor;

bypass paths through which the high-pressure, high-temperature, and gaseous refrigerant obtained by compression of the compressor passes, each bypass path communicating a low-pressure passage portion of the return path of the main pipe and a high-pressure passage portion of the forward path of the main pipe between the compressor and the condenser; and

an open/close valve provided in the bypass path in such a manner that the open/close valve may be opened and closed; wherein

a mesh body is disposed in a region of the low-pressure passage portion of the return path of the main pipe facing a tip opening of the bypass path, the high-pressure, high-temperature, and gaseous refrigerant ejected from the tip opening of the bypass path hitting the mesh body.

[0008]

[Operation and Effect of the Invention]

In the invention as set forth in claim 1, the high-pressure fluid in the high-pressure passage of the high-pressure pipe body ejects to the low-pressure passage of the low-pressure pipe body from the tip opening. The

high-pressure fluid, after having ejected, hits the mesh body. The unpleasant high-frequency sound that has been produced so far may be thereby reduced or avoided. Thus, the invention is advantageous for improving silence and comfort.

[0009]

In the invention as set forth in claim 2, the refrigerant in the gaseous state is compressed by the compressor, thereby being brought into the high-pressure and high-temperature state. The refrigerant then reaches the condenser. The refrigerant is condensed by the condenser to the liquid. The refrigerant that has passed through the condenser is expanded by the expander, thereby being brought into a low-pressure and low-temperature state. Then, the refrigerant flows through the group of evaporators, where the refrigerant deprives heat around the evaporator group to generate cold heat. When a cooling load is small in the invention as set forth in claim 2, the open/close valve is opened. The bypass path is thereby opened. Thus, a portion of the high-pressure, high-temperature, and gaseous refrigerant obtained by compression by the compressor does not flow through the condenser, and directly returns to the low-pressure passage portion of the return path of the main pipe through the bypath path. At this time of return, the high-pressure, high-temperature, and gaseous refrigerant hits the mesh body. The unpleasant high-frequency sound that has been produced so far may be thereby reduced or avoided.

[0010]

Accordingly, the invention as set forth in claim 2 is advantageous for improving silence and comfort when the air conditioner is operated. The remainder of the high-pressure and high-temperature, and gaseous refrigerant, which does not flow through the bypass paths, flows through the condenser,

expander, and evaporator group. The refrigerant then evaporates to produce cold heat at the evaporator group.

[0011]

[Embodiments]

Embodiments of the present invention will be described below, based on Figs. 1 to 3. Referring to Fig. 1, a low-pressure pipe body 5 is made of a metal pipe, and includes a low-pressure passage 50 through which a fluid of a low pressure (which may be selected as necessary, and is in a range of 2 to 6 kg/cm^2, for example) flows. The low-pressure pipe body 5 includes a first pipe body 51 of a small diameter, a second pipe body 52 of a large diameter, and a third pipe body 53 of a small diameter. A high-pressure pipe body 6 is made of a metal pipe. Two high-pressure pipe bodies 6 are provided in proximity in a row arrangement. The high-pressure pipe body 6 includes a high-pressure passage 60. A fluid of a pressure (which may be selected as necessary, and is in a range of 10 to 60 kg/cm^2, for example) higher than the fluid of the low-pressure passage 50 flows through the high-pressure passage 60. The high-pressure pipe body 6 is coupled to the low-pressure pipe body 5 by welding or brazing. Accordingly, a tip opening 60a of the high-pressure passage 60 is communicated to the low-pressure passage 50.

[0012]

As shown in Fig. 1, the tip opening 60a is disposed projecting to the low-pressure passage 50 by a dimension of $\Delta L1$. The high-pressure pipe body 6 is disposed crossing the low-pressure pipe body 5 in a generally orthogonal direction. An angle of crossing of the high-pressure pipe body 6 and the low-pressure pipe body 5 is not limited to be orthogonal, and may be selected as necessary. As shown in Fig. 1, a mesh body member 7 is disposed generally coaxially with the low-pressure pipe body 5 in a region of the low-pressure passage 50 of the low-pressure pipe body 5 facing

the tip openings 60a of the high-pressure passages 60. The mesh body member 7 is constituted from a metal ring portion 70 including a dual ring, and a mesh body 71 made of stainless steel. One end portion of the mesh body 71 is held by the dual ring of the metal ring portion 70. The mesh body 71 includes a meshed cylindrical side wall 71 and a meshed bottom wall 71b. The number of meshes of the mesh body 71 is on the order of 100 meshes.

[0013]

In this embodiment, the mesh body member 7 is press fit into the second pipe body 52. End portions 52f and 52i of the second pipe body 52 are then narrowed down. With this arrangement, the mesh body member 7 is incorporated into the low-pressure pipe body 5. With the press fitting and narrowing down, a property of holding the mesh body member 7 in the low-pressure pipe body 5 is ensured. In this embodiment, the first pipe body 51 is disposed over the third pipe body 53. Then, the metal ring portion 70 is disposed over the mesh body 71. The positional relationship is not limited to this example.

[0014]

In this embodiment, the low-pressure fluid flows through the low-pressure passage 50 of the low-pressure pipe body 5 in a direction of an arrow P1 shown in Fig. 1. The high-pressure fluid flows through the high-pressure passage 60 of the high-pressure pipe body 6 in a direction of an arrow P2 shown in Fig. 1. The high-pressure fluid then ejects into the low-pressure passage 50 from the tip opening 60a of the high-pressure pipe body 6. At this time of ejection, the high-pressure fluid hits the side wall 71a of the mesh body 71 of the mesh body member 7. An unpleasant high-frequency sound that has been hitherto produced is thereby reduced. This reduction of the high-frequency sound is confirmed by a test. It is inferred that the reason for

the reduction of the high-frequency sound is that occurrence of an abnormal turbulent flow may be reduced by the mesh body 71 of the mesh body member 7.

[0015]

When the high-pressure fluid of the high-pressure pipe body 6 hits the mesh body 71 of the mesh body member 7, the high-pressure fluid may pass through the meshes of the mesh body 71. Alternatively, the high-pressure fluid may flow around the mesh body 71. When the pressure of the fluid of the high-pressure passage 60 is high and the strength of the mesh body 71 is not sufficient, ejection of the high-pressure fluid may cause the cylindrical side wall 71a to be abnormally deformed. The effect of the mesh body 71 of reducing the unpleasant high-frequency sound may be impaired in this case. The mesh body 71 in this embodiment has the bottom wall 71b. Thus, a reinforcing action of the bottom wall 71b may be expected. The cylindrical-shape maintaining property of the side wall 71a of the mesh body member 7 is therefore increased. This increase in the cylindrical-shape maintaining property is advantageous for reducing or avoiding the abnormal deformation of the cylindrical side wall 71a of the mesh body 71. Accordingly, this embodiment is advantageous for maintaining the effect of reducing the unpleasant high-frequency sound over a long period.

[0016]

In addition, as seen from Fig. 1, the metal ring portion 70 of the mesh body member 7 is disposed on an upstream side, and the mesh body 71 is disposed on a downstream side. The mesh body member 7 is then disposed generally coaxially with the low-pressure pipe body 5 in this embodiment. A smooth flow of the fluid in the low-pressure passage 50 may be therefore ensured. Accordingly, this configuration is further effective for preventing the abnormal deformation

of the side wall 71a of the mesh body 71. Further, according to this embodiment, an effect of collecting dust included in the fluid by the mesh body member 7 may also be expected. Accordingly, when a dust collection member such as a strainer is already equipped, the dust collection effect may be achieved both by the dust collection member and the mesh body member 7. Further, assume that the mesh size of the dust collection member such as the strainer is set to be different from the mesh size of the mesh body member 7. Then, this setting is advantageous for collecting dust according to the mesh size of each of the dust collection member and the mesh body member 7.

[0017]

The number of meshes of the mesh body 71 is not limited to be on the order of 100 meshes, and may be selected as necessary. The number of meshes may be selected as 50 to 100 meshes, 100 to 150 meshes, 150 to 200 meshes, 200 to 250 meshes, 250 to 300 meshes, 300 to 350 meshes, or 350 to 400 meshes, as necessary. The mesh body 71 is formed of the stainless steel, in view of corrosion resistance, heat resistance, strength, and the like, as mentioned above. Accordingly, even when the temperature of the fluid that ejects from the high-pressure passage 60 is rather high (such as 50 to 200°C), making the mesh body 71 of the stainless steel is advantageous for reducing or avoiding heat deformation of the mesh body 71. In this sense as well, this embodiment is advantageous for maintaining the effect of the mesh body 71 of reducing the unpleasant high-frequency sound. The material of the mesh body 71 is not limited to the stainless steel. The mesh body 71 may also be formed of other metal such as an aluminum-based metal, a titanium-based metal, a steel-based metal, or a hard resin.

[0018]

In the example shown in Fig. 1, the inside diameter

of the second pipe body 52 on the side of the third pipe body 53 on the downstream side may also be slightly reduced from the inside diameter of the second pipe body 52 on the side of the first pipe body 51 on the upstream side. The second pipe body 52 is of the large diameter and constitutes the low-pressure pipe body 5. Since the fluid flows in the direction of the arrow P1 inside the low-pressure pipe body 5 in this case, the metal ring portion 70 of the mesh body member 7 tends to be pressed in the direction of the arrow P1 by the fluid that flows in the direction of the arrow P1. Thus, this configuration is advantageous for preventing looseness of the metal ring portion 70. The metal ring portion 79 may thereby securely holds the mesh body 71 in place.

[0019]

Fig. 3 shows another embodiment of the present invention. A configuration of this embodiment is basically similar to that of the embodiment in Figs. 1 and 2. In this embodiment, however, three high-pressure pipe bodies 6 are provided in proximity in a row arrangement. In the embodiment shown in Fig. 3 as well, an effect of reducing an unpleasant high-frequency sound may be similarly expected.

(Application Example) Referring to Fig. 1, a refrigerant circuit 11 in an engine-driven type air conditioner 10 is constituted from a main pipe 12. A compressor 13, an oil separator 14, a switchable four-way switching valve 15, an outdoor heat exchanger 16 that functions as a condenser which condenses a refrigerant (made of chlorofluorocarbons, for example), a first expansion valve 17 that functions as an expander that expands the refrigerant, a receiver 18, a second expansion valve 19 that functions as an expander, a group of indoor heat exchangers 20 each of which functions as an evaporator that evaporates the refrigerant, a refrigerant-coolant heat exchanger 21, and an accumulator

22 having a pressure accumulating function are disposed in series manner on the main pipe 12.

[0020]

A passage of the main pipe 12 that extends from a discharge side 13a of the compressor 13 to the indoor heat exchanger group 20 is set to a forward path 12A. A passage of the main pipe 12 that extends from the indoor heat exchanger group 20 to a suction side 13b of the compressor 13 is set to a return path 12B. The indoor heat exchanger group 20 is formed of a lot of indoor heat exchangers provided in proximity in a row arrangement. In this example, three indoor heat exchangers 20a, 20b and 20c are provided in proximity in a row arrangement. The number of the indoor heat exchangers is not, however, limited to a specific number, and may be arbitrary.

[0021]

The compressor 13 is driven by an engine 23 via a belt 24 to compress the refrigerant in a gaseous state into a high-pressure and a high-temperature state. On the other hand, an engine coolant circuit 25 including a coolant pipe 26 is provided in order to cool the engine 23. A water pump 27, the engine 23, a coolant-exhaust gas heat exchanger 28, a switchable three-way valve 29, the refrigerant-coolant heat exchanger 21, a radiator 30, and a buffer 31 are disposed on the coolant pipe 26.

[0022]

Further, bypass passages 35, 36, and 37 for a high-pressure passage portion of the forward path 12A of the main pipe 12 are provided near the outdoor heat exchanger 16. Bypass valves 32, 33, and 34 are respectively disposed in the bypass passages 35, 36, and 37 as open/close valves. The bypass valves 32, 33 and 34 have different passing flow rates. Accordingly, when the bypass valves 32, 33, and 34 are opened for operation, the refrigerant in the

high-pressure and gaseous state obtained by compression of the compressor 13 is supplied to the bypass passages 35, 36 and 37 in a direction of an arrow E1. In this embodiment, the three bypass valves are used. The number of the bypass valves, are not, however, limited to a specific number, and may be arbitrary.

[0023]

An operation of the engine-driven type air conditioner 10 having the above-mentioned configuration will be described. When the engine 23 is driven for operation based on a command from a user, the compressor 13 is driven via the belt 24. First, a cooling mode in which a cooling operation is achieved by the indoor heat exchanger group 20 will be described. In this case, the refrigerant in the refrigerant circuit 11 is discharged from the discharge side 13a of the compressor 13. The refrigerant is thereby compressed into the high-pressure, high-temperature, and gaseous state. The resulting refrigerant proceeds through the high-pressure passage portion of the forward path 12A in the direction of an arrow A1. Then, the refrigerant reaches the oil separator 14, where compressor lubricating oil in the refrigerant is separated. Next, the refrigerant is sent in a direction of an arrow A2 through the four-way switching valve 15 and reaches the outdoor heat exchanger 16. In the outdoor heat exchanger 16, the refrigerant in the high-pressure, high-temperature, and gaseous state (e.g. 10 to 30 kg/cm^2 at 60 to 110°C) condenses into a liquid by dissipating heat to outside air. Then, the liquid refrigerant proceeds in a direction of an arrow A3, and abruptly expands through the first expansion valve 17, receiver 18, and second expansion valve 19. The liquid refrigerant is thereby brought into a low-temperature, low-pressure, and mist state. The refrigerant further flows in a direction of an arrow A4 into the respective indoor

heat exchangers 20a to 20c of the indoor heat exchanger group 20. The refrigerant in the mist state that has flown into the indoor heat exchanger group 20 evaporates by depriving heat around the indoor heat exchanger group 20. Cold heat is thereby generated. In other words, cooling is performed by the indoor heat exchangers.

[0024]

The refrigerant in a low-pressure, low-temperature, and gaseous state (of e.g. 2 to 6 kg/cm^2 at 0°C) that has passed through the indoor heat exchanger group 20 flows in a direction of an arrow A5 and then in a direction of an arrow A6. Then, the refrigerant flows in a direction of an arrow A7 through the four-way switching valve 15, flows in a direction of an arrow A8 through the refrigerant-coolant heat exchanger 21, flows in a direction of an arrow A9 through the accumulator 22, and then returns to the suction side 13b of the compressor 13. Then, the refrigerant is compressed again by the compressor 13 and flows in the similar manner to the above.

[0025]

In the cooling mode, an engine coolant is discharged from the water pump 27, passes through the engine 23 and the coolant-exhaust gate heat exchanger 28, and cools the engine 23. Then, the engine coolant flows through the radiator 30 and the buffer 31 through the three-way switching valve 29, and returns to the water pump 27 again. Accordingly, because of a switching operation of the three-way switching valve 29, the engine coolant does not flow through the refrigerant-coolant heat exchanger 21. Thus, in the cooling mode, a heat exchange operation is not performed at the refrigerant-coolant heat exchanger 21.

[0026]

Next, a heating mode in which a heating operation is achieved by the indoor heat exchanger group 20 will be

described. In the heating mode, the four-way switching valve 15 is switched to a mode indicated by an arrow K in Fig. 4. In the heating mode as well, the refrigerant is compressed by the compressor 13 into the high-pressure, high-temperature, and gaseous refrigerant. The resulting refrigerant is discharged from the discharging side 13a of the compressor 13. Then, at the oil separator 14, the compressor lubricating oil in the refrigerant is separated. In this heating mode, the four-way switching valve 15 is switched to the mode indicated by the arrow K in Fig. 4 by an electronic control device. Thus, the high-pressure, high-temperature, and gaseous refrigerant flows through the four-way switching valve 15 in a direction of an arrow B1, flows in a direction of an arrow B2, and then reaches the indoor heat exchanger group 20. Then, at the indoor heat exchanger group 20, the high-pressure, high-temperature, and gaseous refrigerant condenses into a liquid by dissipating heat indoors. The refrigerant is thereby brought into a high-pressure, high-temperature, and liquid state. That is, in the heating mode, the indoor heat exchanger group 20 functions as condensers, and heating is performed. Then, the refrigerant flows in a direction of an arrow B3, and then in a direction of an arrow B4. The refrigerant in the liquid state expands after passing through the second expansion valve 19, receiver 18, and first expansion valve 17. The refrigerant in the liquid state is thereby brought into the low-temperature, low-pressure, and mist state. Then, the refrigerant evaporates through the outdoor heat exchanger 16. The refrigerant thereby receives heat from the outside air to be brought into a low-temperature, low-pressure, and gaseous state. That is, in the heating mode, the outdoor heat exchanger 16 functions as an evaporator. The refrigerant that has passed through the outdoor heat exchanger 16 proceeds in a direction of

an arrow B5, reaches the refrigerant-coolant heat exchanger 21 through the four-way switching valve 15, and then returns to the suction side 13b of the compressor 13 through the accumulator 22.

[0027]

In the heating mode, the refrigerant-coolant heat exchanger 21 functions. That is, the engine coolant is discharged from the water pump 27, flows through the engine 23 and the coolant-exhaust gas heat exchanger 28, and then cools the engine 23. The engine coolant is thereby brought into a high temperature state. Then, the engine coolant proceeds in a direction of an arrow C1 through the three-way switching valve 29, flows through the refrigerant-coolant heat exchanger 21, proceeds in a direction of an arrow C2, and then returns to the water pump 27 again. The engine coolant that has become the high temperature state passes through the refrigerant-coolant heat exchanger 21. Then, the engine coolant heats the refrigerant by heat exchange with the refrigerant by the heat exchanger 21, thereby allowing further contribution to improvement in heating capability.

[0028]

In both of the cooling mode and the heating mode, the number of operating units of the indoor heat exchangers 20a, 20b and 20c may be arbitrarily set according to a condition of room use. In this case, the setting may be performed by operation switches provided at the indoor heat exchangers 20a, 20b, and 20c. In this case, an amount of the refrigerant that will flow into the indoor heat exchanger group 20 must be variably controlled according to the number of operating units. Then, open/close states of the bypass valves 32, 33, and 34 are controlled according to the following settings ① to ⑧ by an electronic control device or the like.

[0029]

① All the bypass valves 32, 33, and 34 are closed.

② Only the bypass valve 32 is opened.

③ Only the bypass valve 33 is opened.

④ Only the bypass valve 34 is opened.

⑤ Only the bypass valves 32 and 33 are opened.

⑥ Only the bypass valves 32 and 34 are opened.

⑦ Only the bypass valves 33 and 34 are opened.

⑧ All the bypass valves 32, 33, and 34 are opened.

Naturally, the amount of the refrigerant that will be bypassed through the bypass passages 35, 36, and 37 increases more from the setting ① toward the setting ⑧, and the amount of the refrigerant that will flow into the indoor heat exchanger group 20 is reduced more from the setting ① toward the setting ⑧.

[0030]

In the example shown in Fig. 4, the amount of the refrigerant that will flow into the indoor heat exchanger group 20 may be variously changed according to open/close operations of the bypass valves 32, 33, and 34 having different passing flow rates. An appropriate amount of the refrigerant may be supplied to the indoor heat exchanger group 20 according to a variation in the number of operating units of the indoor heat exchanger group 20. Even if the number of operating units of the indoor heat exchanger group 20 has been varied in such a manner, the amount of the refrigerant flown into the indoor heat exchanger group 20 does not become excessive. Thus, a problem such as abnormality in pressure of a refrigerant system does not arise.

[0031]

Reference character W in Fig. 4 indicates a merging portion in which the high-pressure, high-temperature, and gaseous refrigerants that flow through the bypass passages 35, 36 and 37 merge at a low-pressure passage portion of

the return path 12B. Merging of the refrigerants may be performed in both of the cooling mode and the heating mode. The refrigerant in the gaseous state that has been compressed by the compressor 13 flows through each of the bypass passages 35, 36, and 37. Thus, each of the bypass passages 35, 36, and 37 is in a high-pressure and high-temperature state. That is, when the bypass valve 32 is opened, the high-pressure, high-temperature, and gaseous refrigerant in the bypass passage 35 flows in the direction of the arrow E1, passes through the merging portion W, and then flows through the return path 12B on a low-pressure side. When the bypass valve 33 is opened, the high-pressure, high-temperature, and gaseous refrigerant in the bypass passage 36 flows in the direction of the arrow E1, passes through the merging portion W, and then flows through the return path 12B on the low-pressure side. When the bypass valve 34 is opened, the high-pressure, high-temperature, and gaseous refrigerant flows in the direction of the arrow E1, passes through the merging portion W, and then flows through the return path 12B on the low-pressure side.

[0032]

The mesh body member 7 shown in Fig. 1 is equipped with the merging portion W described above. That is, the mesh body member 7 is equipped in the region of a low-pressure passage of the return path 12B facing tip openings of the bypass passages 35 and 36 in the manner as shown in Fig. 1. In this case, the return path 12B serves as the low-pressure pipe body. Then, the high-pressure, high-temperature, and gaseous refrigerants that have ejected from the tip openings of the bypass passages 35 and 36 hit the mesh body member 7. Accordingly, as described above, this configuration is advantageous for reducing or avoiding a high-frequency sound that has been produced so far by ejection of the high-pressure, high-temperature, and gaseous

refrigerant.

[Brief Description of the Drawings]

Fig. 1 is a vertical sectional view of a piping device;

Fig. 2 is a perspective view of a mesh body member;

Fig. 3 is a vertical sectional view of an essential portion of the piping device; and

Fig. 4 is a diagram showing a configuration of an engine-driven type air conditioner.